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Rec'd ED 5/26/60 11:00

May 23, 1960

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Attention: [redacted] 25X1

We were checking the equipment prior to beginning the laboratory testing phase of Task 16 today. We noticed that, of the five type "B" LRS receivers, we have three which have not been modified to include the silicon transistors. In addition, we have no literature indicating the circuit modifications which were accomplished along with the transistor change.

I would appreciate it if you would arrange to send three additional type "B" receivers and at least one copy of the new schematic at your earliest convenience. Thank you.

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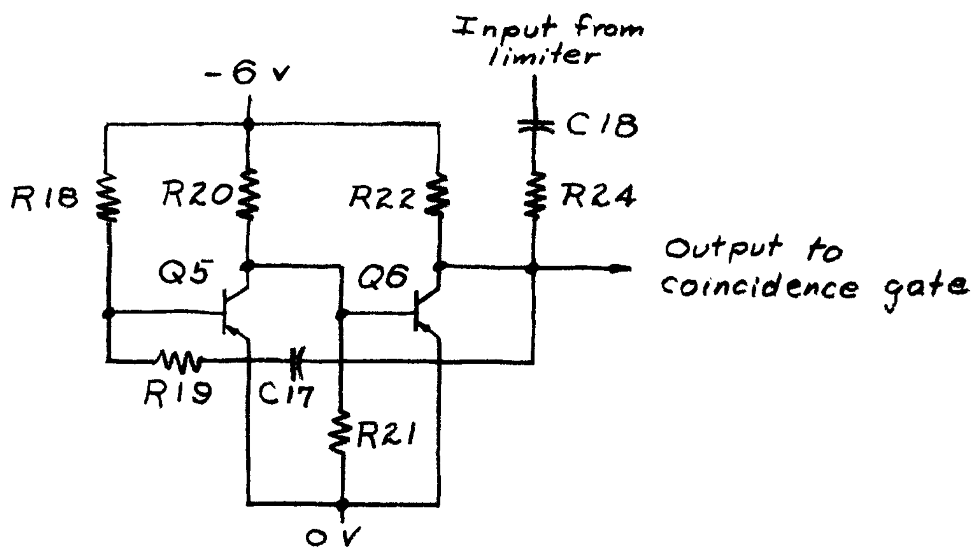
INVESTIGATION OF APPARENT INSENSITIVITY OF LRSR-1B RECEIVERS

Continuing investigation of the receivers under test in US 132, Task XVI, indicated a consistent difference between receiver types. While the Type "A" receivers gave satisfactory performance with an RF input sufficient to produce approximately -1.0 volts at the limiter test point, the Type "B" units required sufficient RF to saturate the limiter (driving it to approximately -0.2 volts) for consistent triggering. The only difference between the two receiver types was the capacitor in the timing loop of the reference multivibrator. A series of experiments was conducted to determine how this capacitor could have an apparent effect on receiver sensitivity, and to find, if possible, a remedy for the situation.



The reference multivibrator portion of the receiver circuit is reproduced in the figure above. It is a mono-stable or "one-shot" multivibrator which is intended to fire on any positive going waveform input from the limiter and which delivers a negative going signal to the coincidence gate at a predetermined interval after it has been triggered. Thus, in the normal operation of the LRS System, this multivibrator flips twice each time the transmitter key is depressed--once at the beginning of the protective pulse and once at the beginning of the operating pulse. The negative going output occurring after triggering caused by the protective pulse has no effect, but the negative going pulse occurring after triggering caused by the operating pulse will be passed by the coincidence gate and will cause triggering of the relay in the receiver.

Upon investigation, it was noted that in the Type "B" receivers, this reference multivibrator was only flipping once unless an RF signal sufficient to saturate the limiter was present. This, then, was the reason for the failure of a lesser RF signal to cause triggering. An examination of the circuit in detail will be necessary to determine a cure for the trouble.

In the normal state, Q5 is conducting and Q6 is not conducting. Any positive going input from the limiter is divided across the combination of R24 and R22, thus raising the collector of Q6 more positive. This lesser positive rise is further coupled by means of C17 to the base of Q5, after further being divided by the combination of R18 and R19. Because of these two successive divisions of the signal, the net rise at the base of Q5 is less than 12% of the rise occurring in the input waveform. If this rise is sufficient to begin to cut off Q5 (as it should be), the voltage at the collector of Q5 will drop. Since this point is directly connected to the base of Q6, Q6 will be turned on. This will cause a further rise at the collector of Q6 which will reinforce the original signal and the whole process occurs essentially instantaneously with the result that Q5 is turned off, and Q6 turned on. C17, which was originally charged plus to minus (reading left to right in the figure) now sees a reversal of potential and begins to charge to the opposite polarity through the path consisting of resistors R22, R18, and R19. When the net charge across C17 has reached approximately zero, the base of Q5 reaches the turn on point since the base of Q5 is held above the collector of Q6 by a voltage equal to the charge across C17. When Q5 begins to turn on, the collector of Q5 rises towards zero volts and this effectively turns off Q6. The ensuing drop in the collector of Q6 will not, however, serve to reinforce the signal causing the turn-on of Q5 since the collector of Q6 will be held with respect to the base of Q5 by the charge on C17. The initial bias conditions will not again be reached until the original plus to minus charge is built up on C17. This must occur through the same path as the discharge occurred--that is through R22, R18, and R19. Thus it takes considerable time. If the second rising waveform occurs at the input before the initial state of charge is reached on C17, this abnormal bias will cause further attenuation of the input signal which will be sufficient to keep the multivibrator from triggering.

Three possible solutions are apparent as follows: i) Reduce the division ratio of the R24-R22 divider by decreasing the magnitude of R24; ii) Reduce the division ratio of the R19-R18 divider by decreasing the magnitude of R19; iii) Increase the length of the transmitted protective pulse by increasing the magnitude of C3 in the transmitter. Of these three methods, method (i) appeared to give the best results on test. Method (ii) also worked, but the width of the operating pulse was more critical than normal--being about 0.5 ms. Method (iii) which involves a change in the transmitter and therefore is the only feasible method for installed equipment, will work, but results in an extremely critical value of pulse width. It is therefore not recommended for a permanent fix. The value of C3 should be increased from 0.068 mf to 0.078 by the addition of a 0.01 mf capacitor in parallel with the existing capacitor.

Method (i) as stated appears to give the Type "B" units performance essentially identical with that of the "A" units. The value of R24 should be changed to 24K. This can be done either by replacing R24 or by paralleling it with another 47K. While this change can also be made in the "A" units, it will result in increasing the sensitivity of those units with the effect that RF signals sufficient to drive the limiter only to -2.0 volts will cause triggering to occur.

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Laboratory Data Sheet

Date______________

Serial No.______________

LRST-1 Transmitter

Checked by______________

I. Follow operating procedure as outlined in the manual.

Filament 6.3 volts AC ±5%

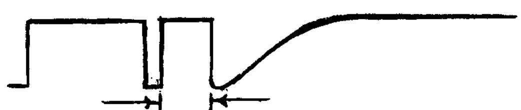
B+ 320 volts DC ±10% in amp. tune position. (after tuning according to instructions)

II. Input voltage range over which meter reads in red area.

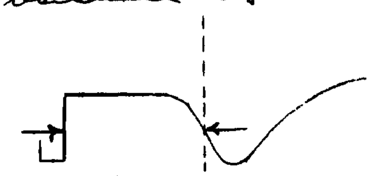
110 volts position.	70 volts to 130 volts
220 volts position.	140 volts to 260 volts

III. Power ____ watts (min. power 7.5 watts). (into known resistance or power meter)

IV. Waveform using diode probe



Variable pulse width transmitter modulation, use positive trigger when monitoring output.



Use negative trigger when measuring pulse width.

V. Pulse Width Range 5-30 millisec.

The following procedure can be used to measure the pulse width settings.

a.) Set oscilloscope on driven sweep with Y calibrate producing 60 cycles equal to 16.7 div. Use negative internal trigger.

$t = 1/f \qquad t = 1/60 \qquad t = 16.7$ millisec.

b.) Using diode probe, set section of pulse marked above to 5 divisions when pulse width adjust dial is set at 5 (Do not change sweep amplitude).

c.) Repeat (b) for 20 millisec. when pulse width is at 20.

Test Equipment

1.) Variac - 0-240 volts
2.) AC Voltmeter - 0-300 volts rms
3.) Multimeter - Simpson 260 or equivalent
4.) Oscilloscope - Dumont 304 or equivalent with long persistent screen.
5.) Diode probe (connected into scope input)
6.) R F Wattmeter or Hewlett Packard
R F Voltmeter and Dummy Load (50 ohms or 200 ohms)

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LABORATORY DATA SHEET

Date______________
Serial No.______________
Checked By______________

LRSR-1 RECEIVER

Supply Voltage 6.5 Volts ±10%
Supply Current (No Signal) ____(3.2 ma max.)*
Supply Current (Max. Signal) ____(5.0 ma max.)*

Sensitivity ____ Millivolts (3 millivolts max.)*

a. The above measurement is made at the antenna terminals.

b. The 50 ohm generator output can be considered as the input signal. The unmodulated R F signal at 6.82 Mc which produces 1 volt at the limiter output is the sensitivity.

(Remove the top cover to measure the limiter voltage.)

Pulse Width Operating Range 14 to 17 "A" unit (15 ±5)* White
~~____ to ____ "B" unit (25 ±5)* Red~~

Use a calibrated transmitter and measure the range of pulse width settings which will operate the unit.

Overall Operation and/or High Level Operation

A portion of the operating range should fall within the range specified and bracketed above.

The units will operate anywhere in the vicinity of the transmitting antenna without overloading.

Test Equipment

1.) Transmitter - LRST-1

2.) Multimeter - Simpson 260, or equivalent

3.) R F Generator - General Radio, 1001-A, or equivalent

( )* Specifications